Project Status Report

Upper Mississippi River
Long Term Resource Monitoring Program
U.S. Geological Survey

Evaluating Agricultural Nonpoint Loadings on Pool 13 from Maquoketa River Watershed, Iowa

by
Dr. Prasanna H. Gowda

Floodplains of the Upper Mississippi River System (UMRS) are continuously receiving high sediment and nutrient (nitrate-N, phosphorus, pesticides) discharges from their tributary watersheds, primarily as a result of nonpoint agricultural runoff, that are affecting the quality of backwaters and contributing to eutrophication. Continued degradation of backwaters by sedimentation and nutrient enrichment are expected to adversely influence aquatic habitat by reducing its extent and diversity within the next 50 to 100 years. Thus, a scientific inquiry is needed to (1) understand the magnitude and spatial patterns of sediment and nutrient loadings and (2) quantify the benefits of alternative potential management strategies for agricultural areas in the Upper Mississippi River Basin. Results would provide a framework for planning and help watershed managers and policy makers develop effective management policies.

The objectives of this research are to (1) predict agricultural nonpoint source loadings of sediment, nitrate-N, phosphorus and pesticides from the Maquoketa River watershed by using an integrated spatial-process model; (2) use observed and predicted runoff, sediment, and agrichemical loadings for model evaluation; and (3) use the model to evaluate potential water quality benefits associated with the adoption of alternative watershed management strategies. This information will assist both the U.S. Department of Agriculture and the U.S. Environmental Protection Agency as well as Pool 13's natural resource managers.

The Maquoketa River watershed (1694 mi^2), located in northeastern Iowa, is an agriculturally predominated watershed of the Upper Mississippi River Basin. Sediment loadings from this watershed drain directly into Pool 13 of the UMRS and have an impact on Pool 13's ecosystems. Figure 1 is an infrared aerial photograph, acquired on September 12, 1989, showing sediment entering Pool 13 from the Maquoketa River. Since 1989, the Environmental Management Technical Center has been monitoring this watershed outlet for nonpoint source loadings. Understanding the pattern of nonpoint source loadings from the watershed to the UMRS will enhance our capabilities of interpreting LTRMP water quality trends in Pool 13.

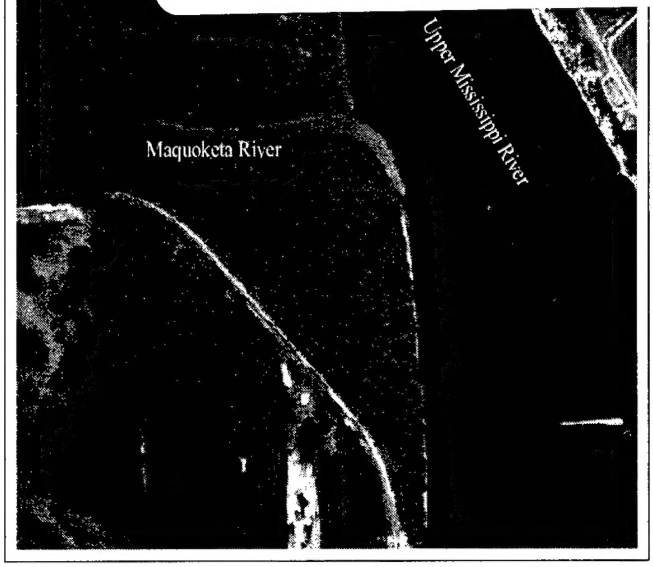

Figure 1. Infrared aerial photograph of sediment particles entering Pool 13 from the Maquoketa River watershed.*

(over)

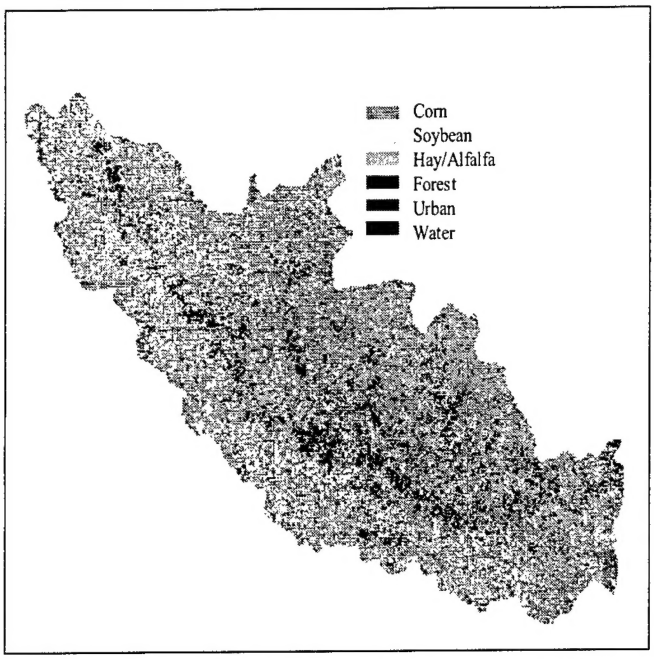

Figure 2. Land cover/land use map of the Maquoketa River watershed for 1995.*

Development of a database for predicting water quality at the watershed level involves preparation of spatial and non-spatial datasets. A Geographic Information System (GIS) database for the Maquoketa River watershed was derived from a variety of sources and georeferenced to the Universal Transverse Mercator (UTM) projection. Computer (Erdas Imagine and Arc/Info) software was used to develop GIS layers for land cover/land use, tillage practices, slope and soil types.

A land cover/land use layer for the watershed was derived from the satellite (Landsat Thematic Mapper) data, acquired on September 1, 1995, using a hybrid classification technique. Figure 2 illustrates the land cover/land use map of the Maquoketa River watershed for 1995. Ground truth data collected from the Farm Service Agency were used for identifying agricultural crops. A TM-based logistic regression model was used to identify tillage management practices (till and no-till) in the watershed using Landsat TM data aquired on March 27, 1996. To avoid non-agricultural areas being classified as till or no-till areas, they were masked out using the land cover/land use map of the watershed. A digital soil layer, showing the soil map units in the watershed, was extracted from the State Soil Geographic (STATSGO) soil database for Iowa and the soil characteristics associated with the soil map units are being derived from the Map Unit Use File (MUUF), a PC- based Natural Resource Conservation Service (NRCS) soil database. A slope map was derived from a 1:250,000 scale USGS digital elevation model. A GIS interface to derive transformed hydrological response units and display hydrographs and associated quality graphs for the watershed has been developed. Currently, the interface is being tested with the GIS database developed for the Maquoketa River watershed. Model input such as planting dates, chemical application rates and climatic data are being collected from a variety of sources, including published reports and surveys.

Study findings and developmental efforts will be disseminated through the publication of two research papers in referred journals. The developed GIS database will be used by staff at the Environmental Management Technical Center and University of Wisconsin-La Crosse to integrate the physical, biological, and socioeconomic components of the watershed in order to develop alternative best management practices. The GIS database will also be made available to the public through the internet. ❐

* The graphics are available in color through the Environmental Management Technical Center's Homepage at http://www.emtc.nbs.gov/

For further information, contact

Dr. Prasanna H. Gowda
U.S. Geological Survey
Environmental Management Technical Center
575 Lester Avenue
Onalaska, Wisconsin 54650
Phone: 608/783-7550, ext. 22
E-mail: phg0@emtc.nbs.gov

Project Status Reports (PSRs) are internal Long Term Resource Monitoring Program documents whose purpose is to provide information on Program activities. Because PSRs are only subject to internal peer review, they may not be cited. Use of trade names does not imply U.S. Government endorsement of commercial products. All LTRMP Project Status Reports are accessible through the Environmental Management Technical Center's Homepage at http://www.emtc.nbs.gov/

October 1997 **PSR 97-11**